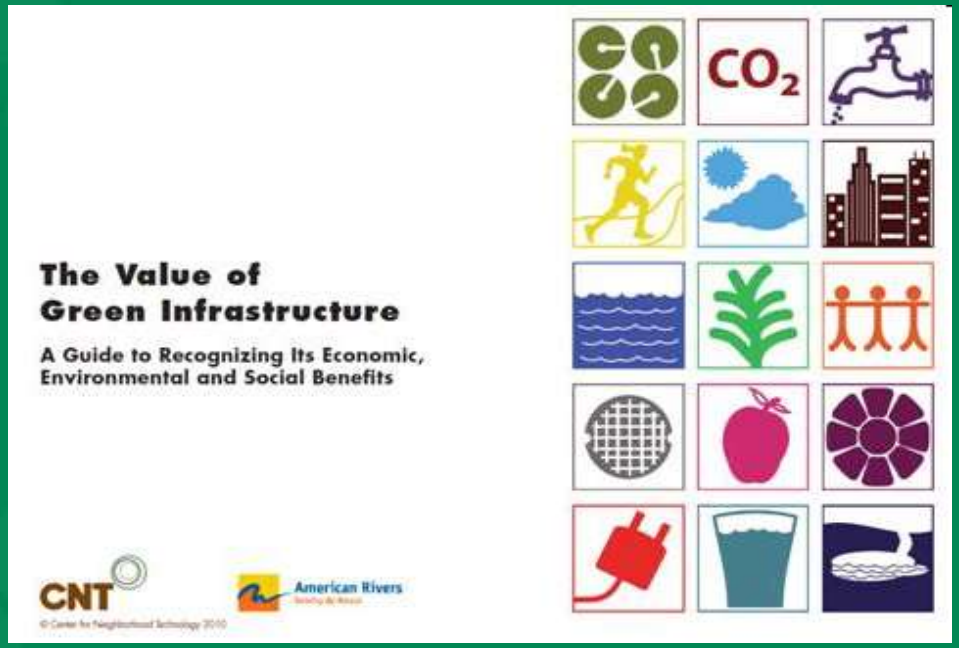
Valuing Green Infrastructure: Economic, Environmental, and Social Benefits



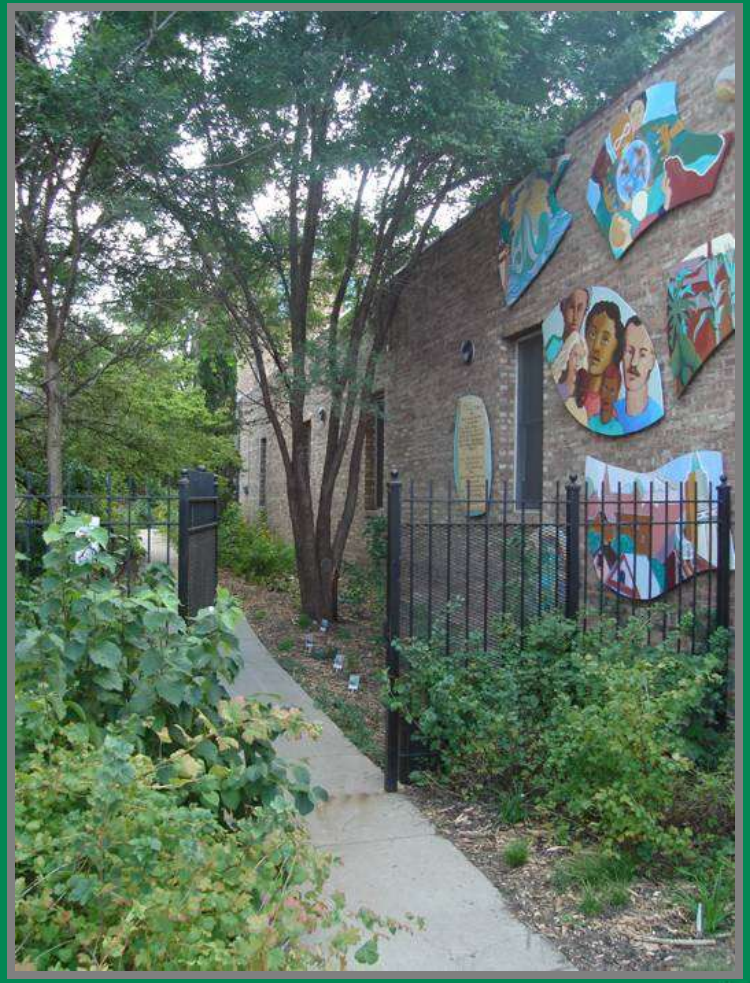
Hal Sprague
Manager - Water Policy
Center for Neighborhood Technology

Vermont Agency of Natural Resources

Webinar – September 26, 2013

Center for Neighborhood Technology

- 35 year-old Chicago-based think-and-do tank for urban sustainability
- Develop and implement strategies that benefit the environment and the economy
  - Transportation
  - Energy
  - Water resources
  - Climate
- Green Infrastructure
  - Planning/Analysis Toolbox
  - Policy Initiatives
  - Education/Demonstration Projects
  - Communities of Practice



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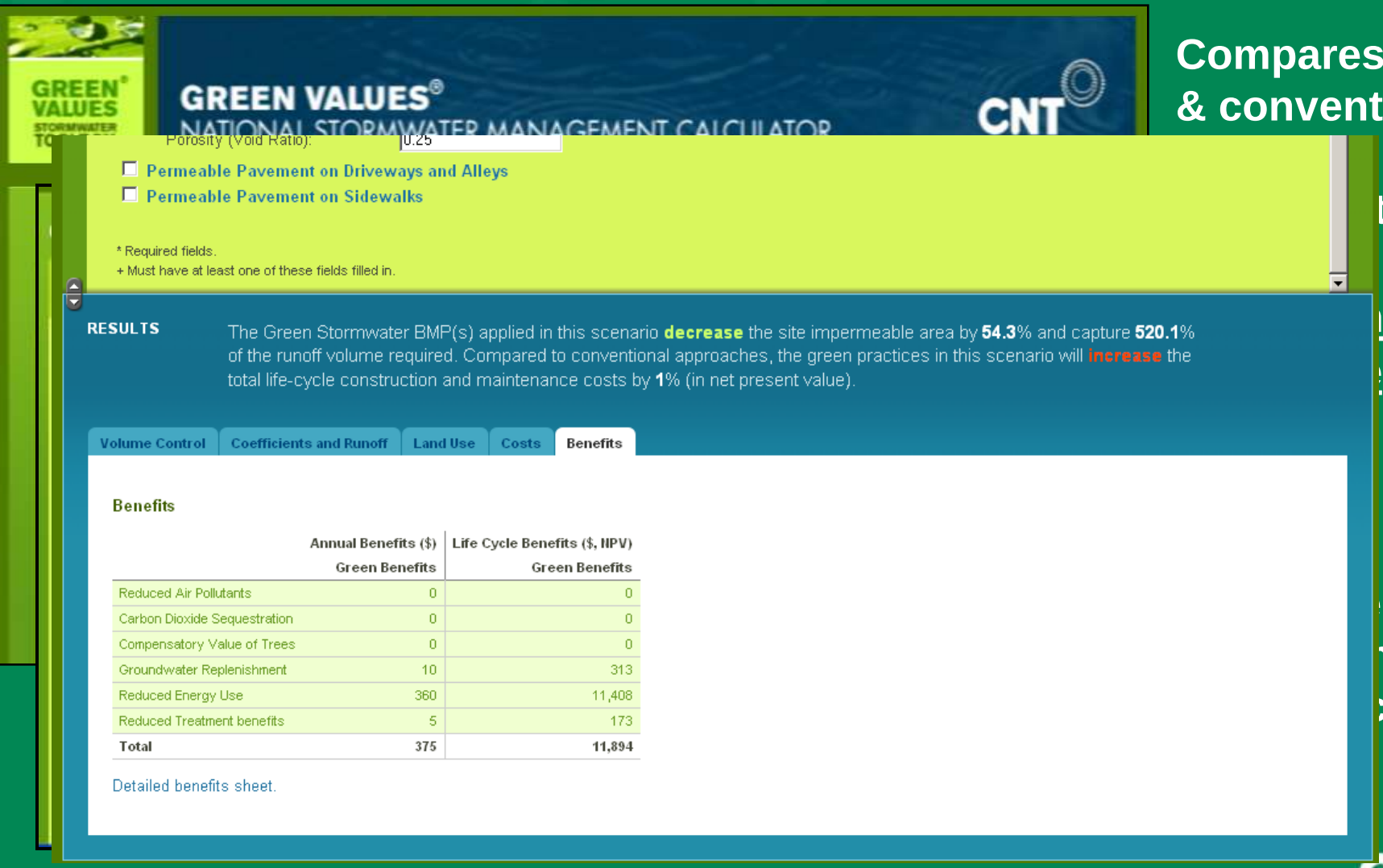
National Green Values Calculator



Compares green & conventional

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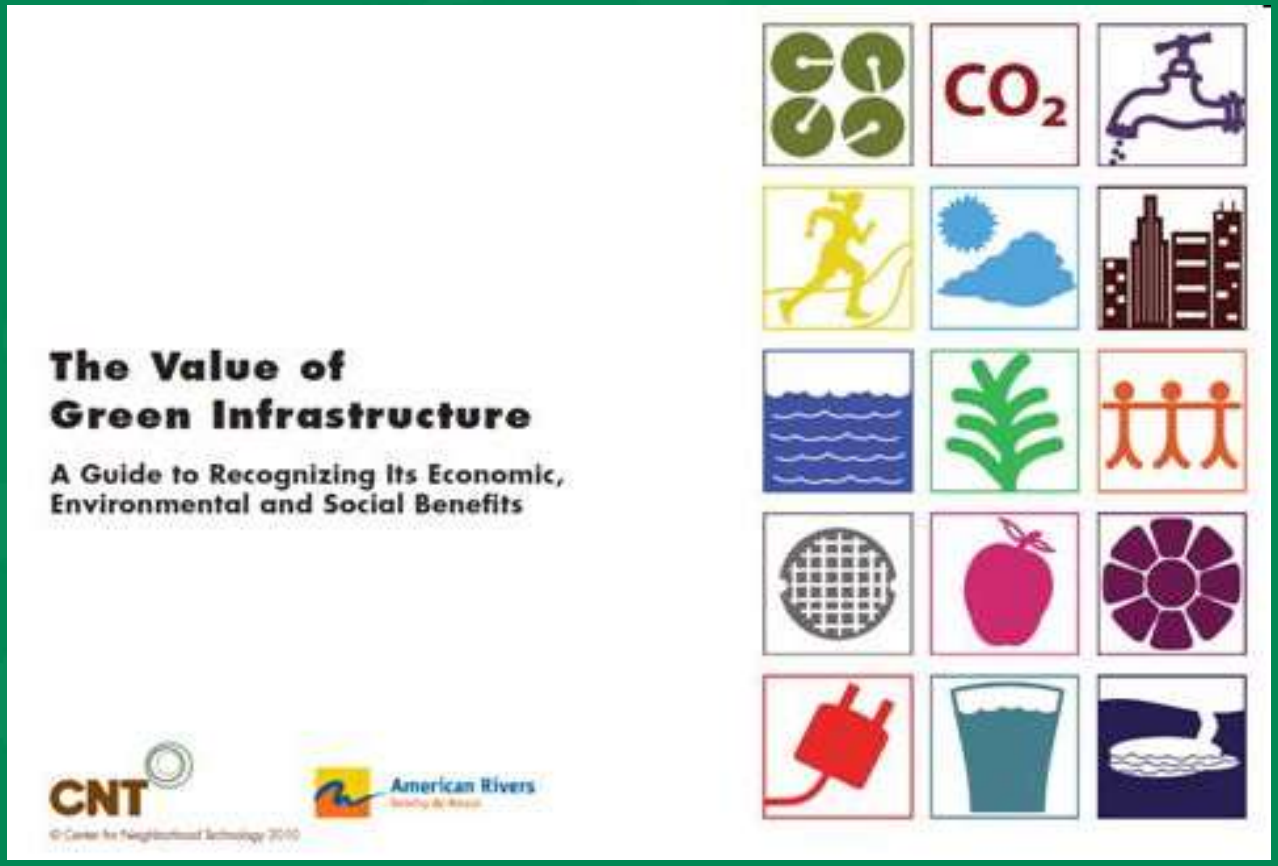
Costs and Benefits of Infrastructure

- Selecting between green and grey infrastructure practices usually involves only a comparison of the costs of each.

- However, when investing taxpayer dollars, such decisions should consider the relative **monetary benefits** of green and grey infrastructure as well as their costs.

CNT's "Valuation Guide"



http://www.cnt.org/repository/gi-values-guide.pdf

2 – Step Process

1. Quantification of Benefits

2. Valuation of Quantified Benefits

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Benefits by GI practice

Practice	Practice Unit	Benefit Units
	Square feet	• Gallons retained on site • KWH treatmt energy saved • LBs of pollutant removed
	Tree (canopy %)	Gallons; KWH energy; LBs of pollutant removed
	Square feet	Gallons; KWH energy; LBs removed; decibels
	Square feet	Gallons; KWH saved (HVAC); LBs removed; decibels
	Gallons	Gallons; KWH energy; gallons potable water saved

Types of Benefits

Water – Treatment costs, water quality, stream erosion, flooding, groundwater and stream recharge, drinking water supply, grey infrastructure needs, de-icing

Energy – Building heating/cooling, water pumping, treatment and storage

Air Quality – Pollutant sequestration, carbon sequestration

Climate – Carbon sequestration, other GHGs

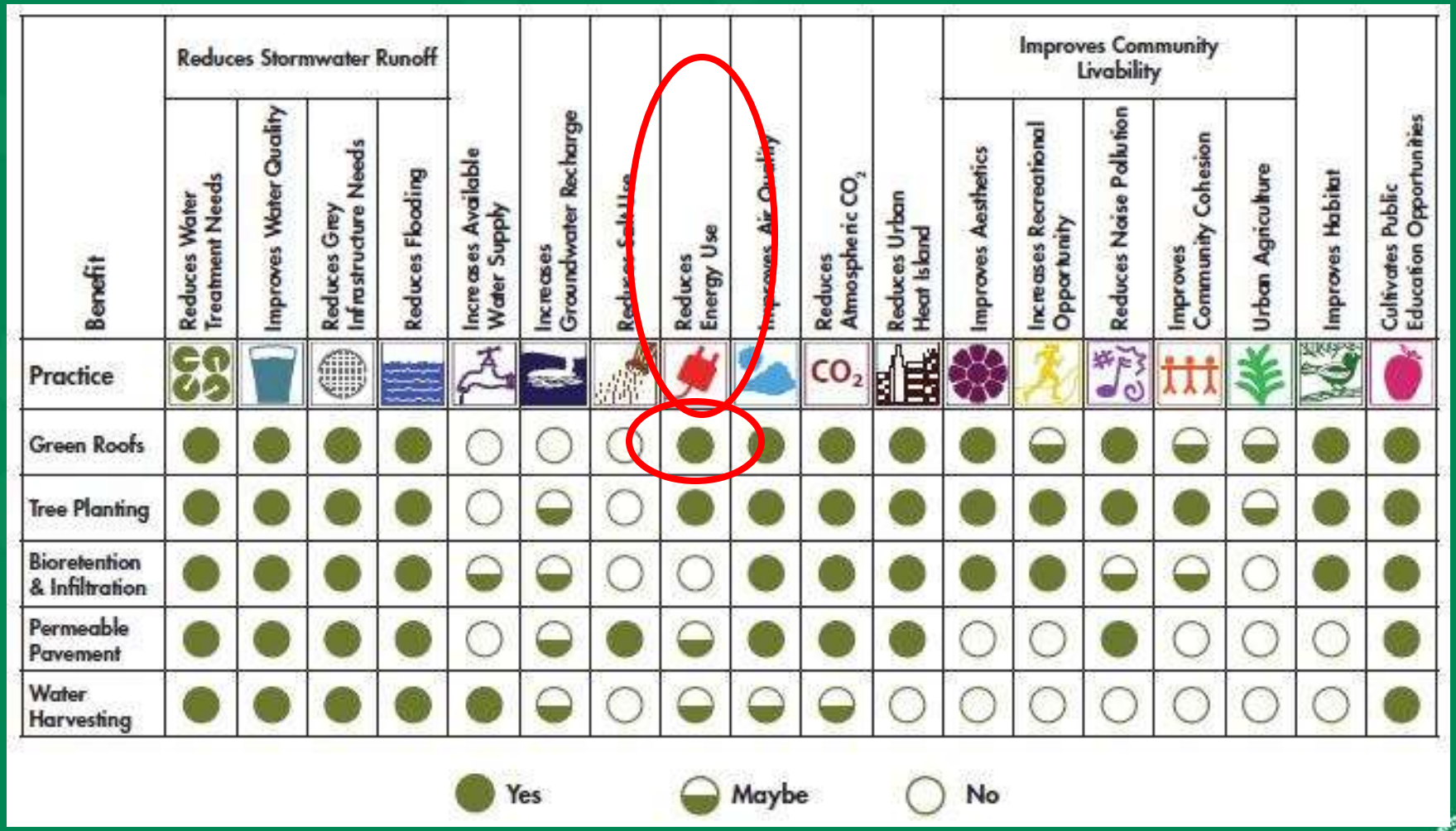
Heat Island – Morbidity, mortality, comfort

Community Livability – Noise, recreation, property value, aesthetics, community cohesion, urban agriculture

Habitat – Biodiversity, ecological health

Public Education

The Value of Reduced Runoff, Energy, Clean Air, Livability



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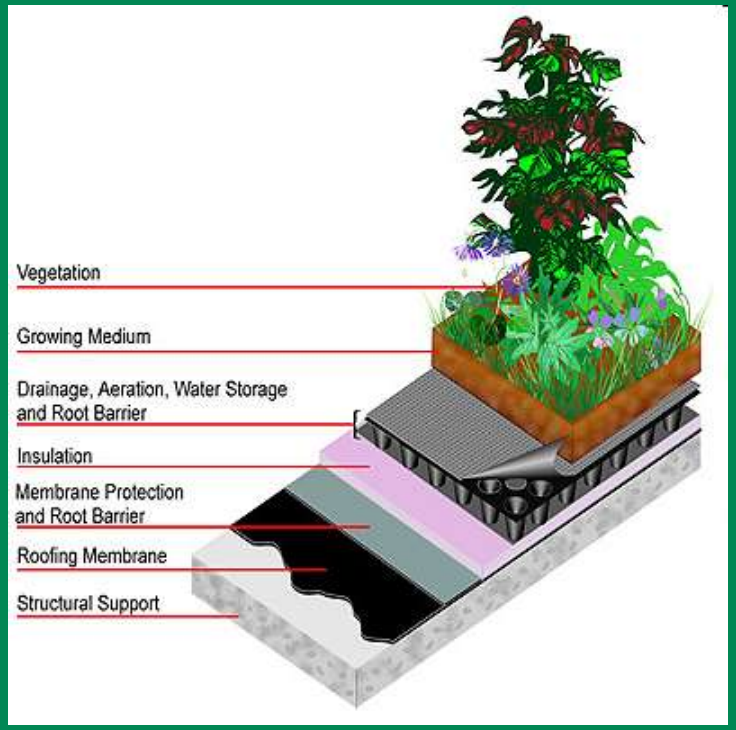
Example: Energy Benefits from a 5,000 S.F. Green Roof (Reduced Energy Use)

Heating degree days (°F days)
x green roof area (SF) x
24 hours/day x ΔU =
Reduced Heating Energy
(Btu/SF)

Where:
U = heat transfer coefficient, or 1/R; and
R = a measure of thermal resistance



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Energy Benefits from Green Roof

$\Delta U = [1/R_{cr} - 1/R_{gr}]$ = Btu/11.34(SF)(°F)(hrs) – Btu/23.4(SF)(°F)(hrs)

6,630°F(Chicago heating degree days) x 24 hr/day x ΔU = **7,231.75** (Btu/SF)

Hypothetical:

7,231.75 x 5,000 SF = **36,158,750 Btu/year**

Monetizing the Benefits

Energy (cost): 36,158,750 Btu x $0.0000123/Btu

= $444.75 annual savings (5,000 S.F. Roof)

Scaling Up the GI…

Chicago City Hall Green Roof
= 20,300 sq ft

Represents $1806 in annual energy savings for City (since 2000)

Chicago: Several years ago, there were >2 million sq ft of green roof installed. Based on that, saving building owners would collectively be saving $177,901/year

Chicago: More recently, we were told >7 million sq ft of green roof completed or under permit review: $622,654/year in savings.

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Cost o[illegible]go, IL

Flood damag[illegible]

- *Through O[illegible] phone calls[illegible] Chicago's [illegible]*
- *That numb[illegible] flooded, since few people call [illegible] investigated further:*
- *One industry estimate puts the number of calls to private contractors in the Chicago region at about 60,000 per year, with the average cost per call at $2,500 (cleaning and flood-proofing.) That's a total of about $150 Million annually.*
- *How would an investment in local green infrastructure compare with these costs?*

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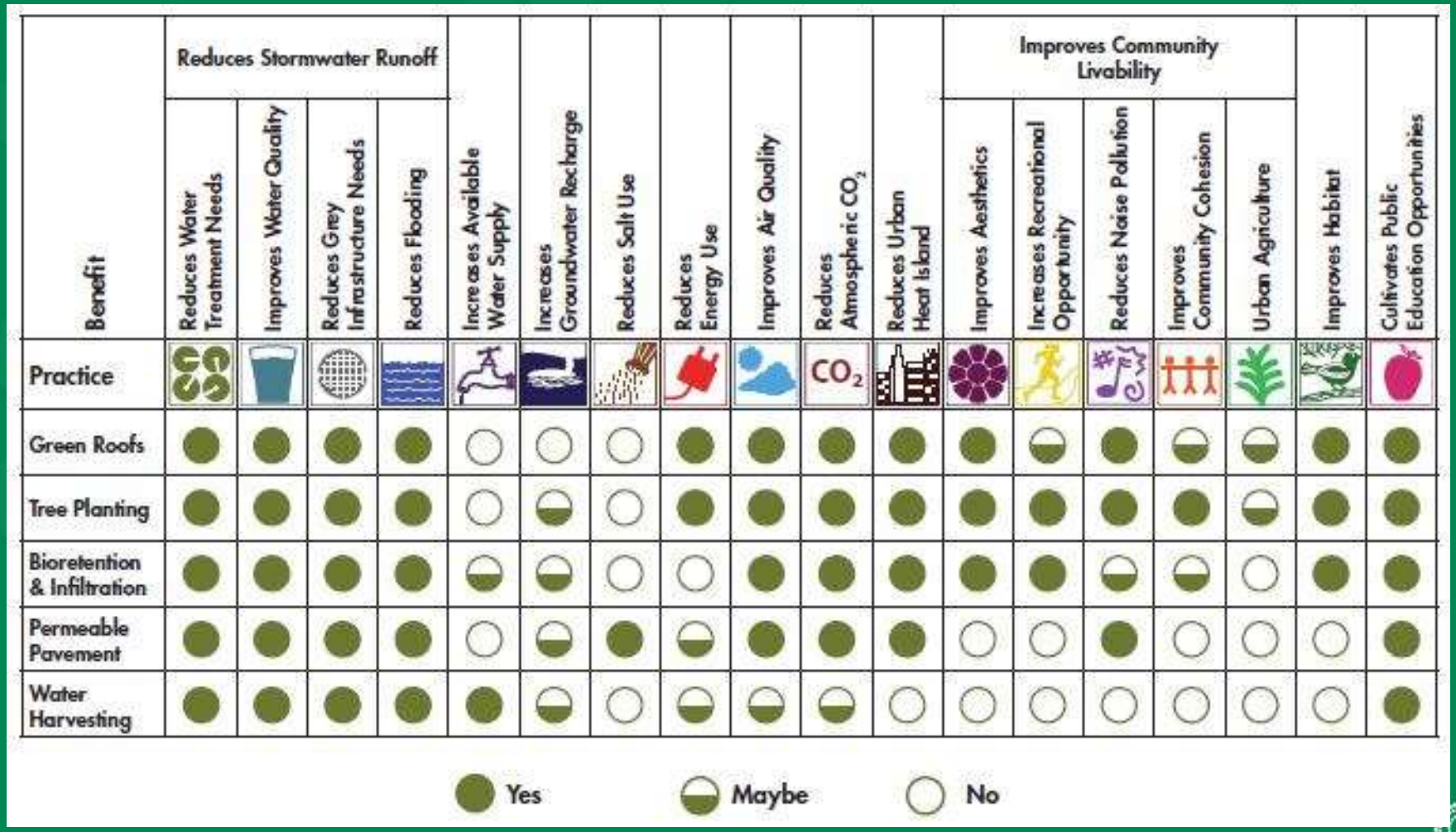
Cumulative Benefits



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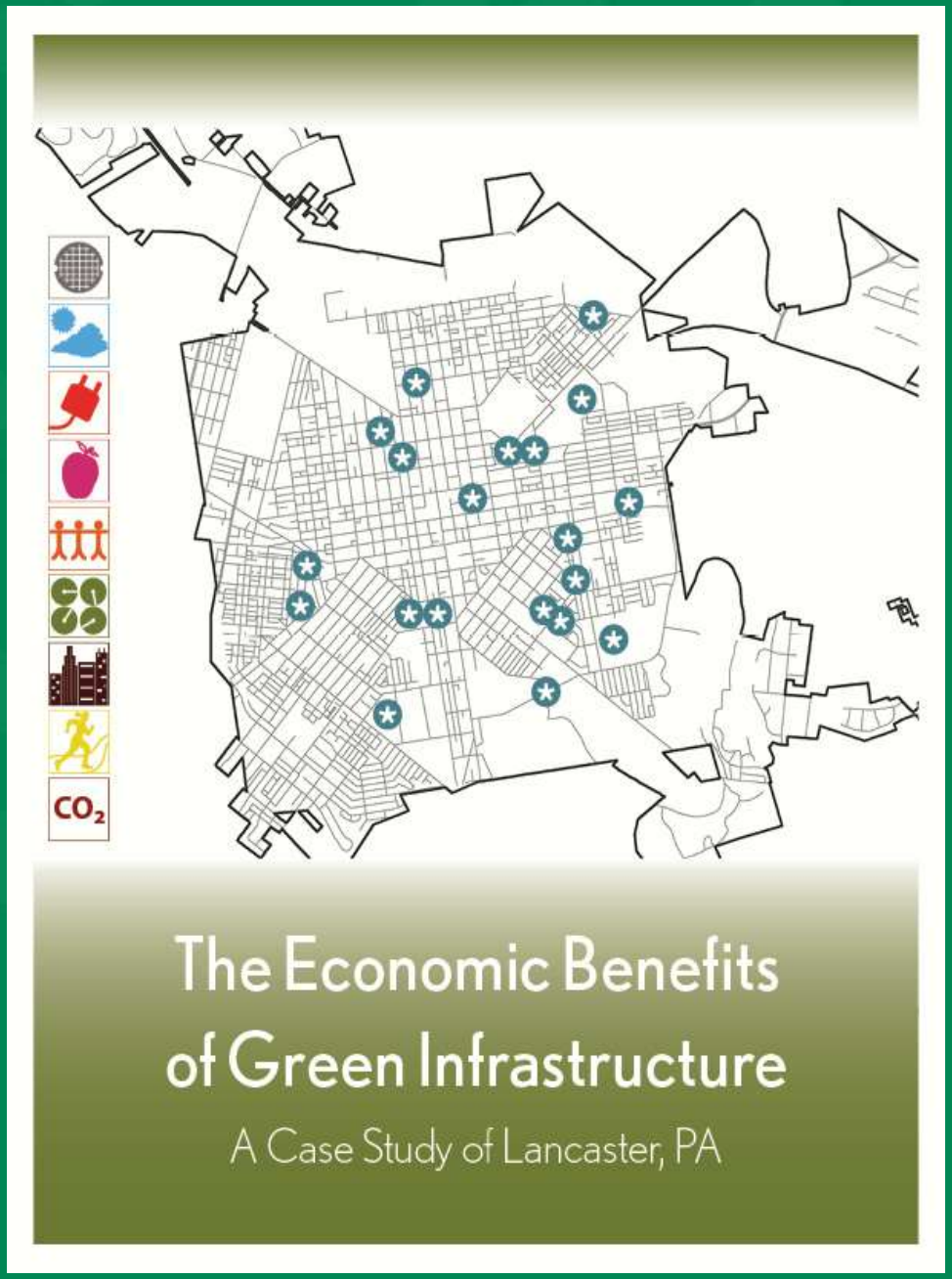

USEPA Study in Lancaster, PA 2013

CNT Primary Consultant

Partners:
American Rivers
TetraTech, Inc.
City of Lancaster
CH2M Hill, Inc.
USEPA

(as yet unpublished)

Lancaster, PA Case Study

Green Infrastructure benefits studied were the reductions in:

- Water treatment needs
- Grey infrastructure needs
- Electricity use
- Natural gas use
- Emissions of air pollutants
- CO_2 emissions

Lancaster, PA Case Study

Green Infrastructure practices planned:

- Green roofs
- Tree planting
- Permeable pavement
- Bioretention & infiltration practices
- Water harvesting

Lancaster, PA Case Study

- Results assume Lancaster reaches its long-term, 25-year goal of 1,053,000,000 gallons of reduced average runoff per year (Green Infrastructure Plan).
- Twenty demonstration projects in the Plan are representative of those practices contributing to achievement of Plan goals.
- Total estimated monetary values are those annual monetary benefits accruing at the end of the Plan's 25-year implementation period.

Lancaster, PA Case Study

Water-Related Benefits

1. Avoided cost of wastewater treatment
2. Avoided cost of grey infrastructure

Green roofs, tree planting, permeable pavement, bioretention & infiltration practices, water harvesting

Estimated benefit of avoided costs for wastewater treatment and infrastructure with the installation of GI at the end of the 25-year implementation period is $122,361,000 per year.

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Lancaster, PA Case Study

Energy-Related Benefits

Reduced electricity and natural gas usage

Green roofs, tree planting, water harvesting: insulation, shading, wind blocking, evaporation

Estimated benefit of reduced energy use through the installation of GI at the end of the 25-year implementation period is $2,368,000 per year.

Lancaster, PA Case Study

Air Quality-Related Benefits

Reduced emissions of nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), particulate matter (PM-10)

Trees, green roofs, permeable pavement, and bioretention and infiltration practices: uptake and absorption, reduced energy emissions, reduced O_3

Estimated benefit from reduced air pollutants with the installation of GI at the end of the 25-year implementation period is $1,023,000 per year.

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Lancaster, PA Case Study

Climate Change-Related Benefits

Reduced CO_2

Vegetation and permeability: reduce atmospheric CO_2 through direct carbon sequestration, reduced water and wastewater treatment, reduced energy production.

Estimated benefit from reduced CO_2 with the installation of GI at the end of the 25-year implementation period was $786,000 per year.

Lancaster, PA Case Study

Additional Benefits






Reduced urban heat island effect, increased property value, reduced noise pollution, increased recreational opportunities, habitat improvement, public education, and community cohesion

Estimated benefit from with the installation of GI at the end of the 25-year implementation period was not calculated.

Calculated Annual Benefits	
Estimated Value from Water Benefits	$122,361,000
Estimated Value from Energy Benefits	$2,368,000
Estimated Value from Air Quality Benefits	$1,023,000
Estimated Value from Climate Change Benefits	$786,000
Estimated Value from other Qualitative Benefits	Not calculated
TOTAL	**$126,538,000**

QUESTIONS?

Thank You

www.cnt.org/water/

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